DESCRIPTION

ELECTRIC POWER SYSTEM

TECHNICAL FIELD

The present invention relates to an electric power system, and to an operating method therefor for stably supplying power while suppressing corona discharge which generates ultraviolet radiation which may cause health problems in humans. Objects are to provide an electric power system, a computer program product for the electric power system, a computer readable medium in which the computer program is recorded, a server in which the computer program is installed, and an operating method therefor.

BACKGROUND ART

Fig. 8 shows a basic diagram of a large electric power system. As shown in Fig. 8, the large electric power system comprises basically electric power generation, transmission of the electric power, and distribution of the electric power. In other words, the electric power system comprises distribution electric power systems in which the main elements are power plants (generating stations), transmission lines, substations, distribution lines, etc., and corresponding control systems, that maintains normal operating conditions, in which the main elements are communication devices, protection devices, and control devices.

As shown in Fig. 8, an electric power system comprises power plants (generating stations) G1, G2 ... Gn, electric power transmission lines H1, H2 ... Hk, substations T1, T2 ... Tm, interconnected transmission lines C1, C2 ... Cj, distribution lines D1, D2 ... Dh, distribution substations U1, U2 ... Ua. The power plants (generating stations) G1, G2 ... Gn are nuclear power stations, hydropower plants, thermal power generation plants, etc. These plants are constructed far from large cities that use large amounts of electric power, due to difficulties in finding cost-effective sites near large cities.

The generated electric power is transformed to higher voltages (500KV, 275KV, 220KV, 187KV, etc.) to decrease transmission loss, and is transmitted to the outskirts of large cities by the electric power transmission lines H1, H2 ... Hk. The transmitted electric power is sent by the substations T1, T2 ... Tm and the interconnected transmission lines C1, C2 ... Cj. It is for the purpose of isolating imbalances in electric power consumption between districts, to integrate electric power generated by many kinds of electric power resources, to supply stable and economic electric power to the consumers.

The unified electric power is transformed to a lower voltages (154 KV to 22 KV), distributed to the distribution substations U1, U2 ... Ua by the distribution lines D1, D2 ... Dh and supplied to customers.

Electric power systems have been researched for a long

time, and stable electric power can therefore be supplied to customers. Electric power is now a crucial base for industrial societies.

The corona discharge that appears when electric power is transmitted at high voltage has been researched, and it was found that the corona discharge may not appear, under common weather conditions, around the transmission and distribution lines.

However, research on the corona discharge on the fields of electric power systems are mainly directed to corona loss, corona noise, and apparatus damage from corona discharge. There is rarely research about corona discharge influences on the human body.

In 1979, Wertheimer and Leeper reported an association between childhood leukemia and certain features of the wiring connecting their homes to the electrical distribution lines. Since then, a large number of studies have been conducted to follow up this important result. Analysis of these papers by the US National Academy of Sciences in 1996 suggested that residence near power lines was associated with an elevated risk of childhood leukemia.

In 1996, the World Health Organization (WHO) established the International Electromagnetic Fields (EMF) Project to address health issues regarding exposure to EMF. The EMF Project is currently reviewing research results and conducting risk assessment of exposure to static and extremely low frequency (ELF) electric and magnetic fields.

The International Agency for Research on Cancer (IARC), a specialized cancer research agency of the WHO, concluded the first step in the WHO health risk assessment process by classifying ELF fields with respect to the strength-of-the-evidence that they could cause cancer in humans on June 2001. WHO Fact sheet No. 263 reported "Two recent pooled analyses of epidemiological studies provide insight into the epidemiological evidence that played a pivotal role in the IARC evaluation. These studies suggest that, in a population exposed to average magnetic fields in excess of 0.3 to 0.4 μT, twice as many children might develop leukemia compared to a population with lower exposures." They also reported that "In spite of the large number of data base, some uncertainty remains as to whether magnetic field exposure or some other factor(s) might have accounted for the increased leukemia incidence."

There is no consistent evidence that exposure to ELF fields experienced in the daily living environment causes direct damage to biological molecules, including DNA. Since it seems unlikely that ELF fields could initiate cancers, a large number of studies have been conducted to determine if ELF exposure can influence cancer promotion or co-promotion. Results from animal studies conducted so far suggest that ELF fields do not initiate or promote cancer. In 1998, a working group examining the issue for the US National Institute of Environmental Health Sciences (NIEHS) concluded that the scientific evidence of the risk to health humans by ELF

magnetic fields is weak. In animal studies in Japan, the phenomenon of childhood leukemia due to ELF magnetic field exposure has not been observed. It is therefore believed that other factors will turn out to be the cause of the childhood leukemia.

After the investigation, the inventor discovered the following.

(1) The corona discharge occurring around transmission lines causes the emission of ultraviolet light. The collision of an electron and a nitrogen molecule causes a band of the nitrogen molecule to be excited at a wavelength of 202.3 nm excitation potential.

(2) The corona discharge changes from glow corona to brush corona to streaming corona as the voltage in the transmission line is increased. When the glow corona occurred, the emission of ultraviolet light was observed. However during the day, this is not observable due to the brightness of sunlight.

(3) The voltage of beginning of corona discharge is much influenced by the weather, the scratches on the transmission lines and dew condensation of transmission lines.

(4) In the past, the radio or television noise generated by corona discharge and the acoustic noise generated by corona discharge were studied. The corona loss that is generated higher voltage than that of glow corona discharge is also studied well. However, the fact that ultraviolet light is emitted at the level of glow corona discharge has not been

studied.

(5) Corona discharge continued for a long time because the maxim voltage of an electric field decreases when the corona discharge begins. Therefore, a human near the corona discharge has a high probability to be exposed for a long time to the ultraviolet light generated by the corona discharge.

There was a rumor that ultraviolet light was regarded good for health for a period, and was not subject to much notice. Lately the effects on human health by ultraviolet light have been examined more seriously. The effect on the skin, eyes and the immune system has been noted.

Children are at especially high risk of suffering damage from exposure to ultraviolet radiation. Fact Sheet N-261 was published on July 2001 by the WHO. However, the exposure limit to ultraviolet radiation was not indicated by the WHO.

From the molecular biology perspective, the DNA of the human body is damaged by ultraviolet radiation. However, the damaged DNA is normally repaired by several repair systems in the human body.

The repair systems in children are sometimes not effective. If children are exposed on ultraviolet radiation for a long time, it may be beyond the repair limit.

In addition, ultraviolet light influences the immune system of the human body. The mechanism by which ultraviolet light decreases the immune system is considered to be as follows.

In the epidermis of the skin, there are many Langerhans

cells having the shape of a spread palm. The Langerhans cell obtains the information that a foreign object has entered the human body, then moves to a lymph node and transmits the information to lymphocytes for the lymph node dealing with the foreign object.

If the Langerhans cells are destroyed by ultraviolet light, it is difficult to obtain the foreign object invasion information. The lymphocytes can not receive the information, and the immune system cannot equate.

According to the above research, the corona discharge generates ultraviolet light even at the glow corona level. The ultraviolet light contains ultraviolet radiation that are harmful to the human body. If humans are living near high voltage transmission lines, the same symptoms as exposure to harmful ultraviolet light are expected. UV radiation is classified as probably carcinogenic to humans (usually based on strong evidence of carcinogenicity in animals) in WHO Fact Sheet NO. 263.

According to the above facts, I believe that the risk of childhood leukemia near high voltage transmission lines, which is admitted by the epidemiologic research, is mainly caused by harmful ultraviolet light generated by corona discharge.

Therefore, it is necessary to stop corona discharge, even at the glow corona level, by decreasing the transmission voltage rapidly. It is also important to maintain the trust that electric power is safe and convenient. The trust is established by long term efforts by electrical engineers.

I cannot find documents regarding suppressing corona discharge for stopping ultraviolet light generation. There are several documents about suppressing corona discharge for the prevention of damaging power apparatuses, prevention of broadcasting noise, and reducing corona power loss.

Patent document 1: Japanese Unexamined Patent Application Publication No. H11-038078

Patent document 2: Japanese Unexamined Patent Application Publication No. H10-038957

Non-Patent Document 1: Japan Electrical Engineering Handbook Sixth Edition, pages 485 to 486, 1005 to 1023, and 1225 to 1226

Non-Patent Document 2: Japan Electrical Engineering, Ionized Gas Discussion, pages 28 to 51, and 103 to 114

Non-Patent Document 3: World Health Organization (WHO) Fact Sheet No. 263, Electromagnetic fields and public health: extremely low frequency fields and cancer

Non-Patent Document 4: World Health Organization (WHO) Fact sheet No. 205, Electromagnetic fields and public health: extremely low frequency (ELF)

Non-Patent Document 5: World Health Organization (WHO) Fact sheet No. 261, Protecting Children from Ultraviolet Radiation.

Non-Patent Document 6: The National Institute for Environmental Studies (NIES), Epidemiologic study on childhood cancers in Japan (1999 - 2002), by Dr. Michinori Kabuto

Non-Patent Document 7: Central Research Institute of Electric Power Industry, CRIEPI Review, No. 47 page 56

Non-Patent Document 8: Central Research Institute of Electric Power Industry, A Study on Audible Noise from AC and DC Transmission Lines, by M. Fukushima

Non-Patent Document 9: Central Research Institute of Electric Power Industry, Corona Effects of UHV AC Overhead Transmission Lines, by T. Sasano, S. Tomita, K. Tanabe, Y. Deguchi, and H. Harada

Non-Patent Document 10: Maruzen Ltd., Molecular Biology, by Seiichi Tanuma, page 81

DISCLOSURE OF THE INVENTION

Objects of the Invention

An object of the invention is to provide the electric power system stably supplying electric power while suppressing corona discharge that generates ultraviolet light which is harmful to the human body (for example, the cause of childhood leukemia). The corona discharge start voltage varies with the weather, the level of scratches when the transmission lines were wired, and the level of weathering of wires. Therefore, it is not economical to set a low transmission voltage for the whole system to stop the corona discharge, because the transmission capacity is extremely limited.

It is also not practical to detect corona discharge over the entirely of the power transmission lines that is wired over extremely long distances. It is desirable to suppress corona discharge practically, economically, and effectively.

SUMMARY OF THE INVENTION

In this invention, the data which are related to the beginning of corona discharge on each transmission line are recorded in a memory means in advance. Data on weather forecasts is inputted for each district so as to calculate the estimated corona discharge start voltage for each transmission line with a computer. If the calculated corona discharge beginning voltage of a transmission line is lower than the normal transmission voltage of the line, the countermeasures of the transmission voltage that are recorded in the memory means in advance are selected to set transmission voltage of the transmission line. The calculation of the estimated corona discharge start voltage and selecting of set transmission voltage are executed on all transmission lines in the electric power system. The set transmission voltage data are inputted to a power system analysis means. The power system analysis means analyze the load of the apparatuses of the power system. According to the analysis result, specific countermeasures are adopted by the apparatuses of the power system. Therefore, an electric power system for stably supplying power while suppressing corona discharge is achieved.

Another method of this invention for solving the problem is to install a corona discharge detecting means and a sending means which sends the detected data, on transmission lines near places where people reside. If the means detects corona discharge, the sending means sends the detected data to a power system analysis means. The power system analysis means

analyze the load of the apparatuses of the power system under the conditions that the transmission voltage of the detected line is lowered. According to the analysis result, the specific countermeasures are adopted to the apparatuses of the power system. Therefore, an electric power system for stably supplying power while stopping the generation of ultraviolet radiation, which is harmful to humans, on short time is achieved.

By this invention, the corona discharge that continues for a long time and generates harmful ultraviolet light is suppressed for power transmission lines.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a preferred mode for carrying out this invention.

Fig. 2 is a process flow chart of a digital processing unit in this invention.

Fig. 3 is an example of weather forecast data.

Fig. 4 is an example of data on transmission lines.

Fig. 5 is an example of data of transmission voltage set for transmission lines.

Fig. 6 is a block diagram of example 3 for carrying out this invention.

Fig. 7 is a block diagram of another example for carrying out this invention.

Fig. 8 is a basic diagram of a large electric power system.

PREFERRED MODE FOR CARRYING OUT THE INVENTION

An electric power system comprises a weather data input means which inputs weather data, for example temperature, atmospheric pressure and weather, etc., at the district of each operating transmission line, memory means which stores each transmission line data and processed data by digital processing unit, digital processing unit which calculates corona discharge start voltage of each transmission lines and decides set transmission voltage of the transmission line, adjust apparatuses which adjusts each line transmission voltage to the set transmission voltage, and a power system analysis means.

Data on weather forecasts is inputted for each district. The digital processing unit calculates the estimated corona discharge start voltage for each transmission line by the data in weather forecasts. If the calculated corona discharge start voltage of a transmission line is lower than the normal transmission voltage of the line, the countermeasures transmission voltage that is recorded in memory means in advance is selected to set transmission voltage of the transmission line. If the calculated corona discharge start voltage of a transmission line is above the normal transmission voltage of the line, the normal transmission voltage is selected to set the transmission voltage of the transmission line.

The power system analysis means analyze the load of the apparatuses of the power system. According to the analysis

result, specific countermeasures are adopted to the apparatuses of the power system. Therefore, the electric power system can stably supply electric power economically and effectively while suppressing corona discharge.

The invention of claim 2 is an electronic computer comprises weather data input means which inputs weather data, for example temperature, atmospheric pressure and weather, etc., at the district of each operating transmission lines, memory means which stores each transmission line data, digital processing unit which calculates corona discharge start voltage of each transmission line, deciding means which sets transmission voltage of the transmission line, and output means which outputs each line's set transmission voltage.

In the computer, the computer program product comprises data on weather forecasts being inputted step, calculating the estimated corona discharge start voltage for each transmission line by the data on weather forecasts step, if the calculated corona discharge start voltage of a transmission line is lower than the normal transmission voltage of the line, the countermeasures transmission voltage that is recorded in memory means in advance being selected to set transmission voltage of the transmission line step, if the calculated corona discharge start voltage of a transmission line is above the normal transmission voltage of the line, the normal transmission voltage being selected to set transmission voltage of the transmission line step, outputting or sending the set transmission voltage of all transmission lines step.

By adopting the set transmission voltage of all transmission lines that do not generate corona discharge, the total automated operating system of electric power can stably supply electric power economically and effectively while suppressing corona discharge.

The invention of claim 5 is an electric power system. In the electric power system, a corona discharge detecting means are installed on transmission lines near places where people reside, and a sending means sends the detected data to a power system analysis means. If the detecting means detects corona discharge, the transmission voltage is lowered to stop the corona discharge.

In the electric power system, recalculation of transmission route is performed for stably supplying power.

The corona discharge detecting means comprises a device that detects ultraviolet level electromagnetic waves. The corona discharge detecting means is set so as to receive the ultraviolet light that is generated by corona discharge on the target transmission line. In this case, the corona discharge detecting means has to perform detection during the day. Therefore, it is desirable to adopt a filter that the ultraviolet light generated by corona discharge has to be distinguished from that from the Sun.

First Embodiment

Fig. 1 is block diagram of a preferred mode for carrying out this invention. Fig. 2 is the process flow chart of digital processing unit in this invention. Fig. 3 is an

example of weather forecast data. Fig. 4 shows an example of data on transmission lines. Fig. 5 is an example of data of transmission voltage set for transmission lines.

In the embodiment of Fig. 1, weather data input means 7, digital processing unit 8 and memory means 9 are added to the basic structure of large electric power system shown in Fig. 8. Moreover, power system analysis means 10 and transmission voltage regulating means 11 are need to be changed as much as to operate by the set transmission voltage that is after described below.

The weather data input means 7 is the means that inputs weather forecast data as shown in Fig. 3 to digital processing unit 8, and it is possible to realize this by connecting a commercial modem (for example, NEC Aterm IT21L) to a personal computer.

The digital processing unit 8 is the device that processes the Fig. 2 flow chart process, and it is possible to realize this by personal computer which has more than an 8 bit central processing unit. The digital processing unit 8 may also realize this by a digital signal processor.

The memory means 9 is a means that stores each transmission line data and processed data by digital processing unit 8. The memory means may be realized by a hard disk drive, semiconductor memory, etc. The memory means may use personal a computer internal memory.

According to Fig. 8, the processing details of the digital processing unit 8 are explained. When the software of

the digital processing unit 8 starts, the digital processing unit 8 sets n to 1 at first (S10). Next, the digital processing unit 8 inputs weather forecast data by the weather data input means. The weather forecast data are temperature, atmospheric pressure and weather of the set district of each transmission lines are desirably input every 2 hours. Thereafter, the data of first recorded transmission line 21 is read from the memory means 9 (S30). The example data of each transmission line are shown in Fig. 4. The contents of the data of each transmission line are Object for which corona discharge is to be suppressed or not, Use past data, Normal transmission voltage, area where set up, Surface coefficient of wire m0 and coefficient k that is decided by the design of transmission line, and Countermeasures voltage. These data are pre-recorded in memory means 9. The reason for setting the data of the object for which corona discharge is to be suppressed or not is that some transmission lines are laid in nonresidential areas and is not a problem to human health. The reason for setting the data of Using past data or not is that in the case of actual corona discharge observation executed, the actual data and that conditions should be recorded. Some transmission lines are so long that the area where set up, are more than two areas.

It is decided that the transmission line is the object for which corona discharge is to be suppressed or not (S40). If the transmission line is not the object, the normal transmission voltage that has been recorded is set for

transmission voltage (S100). If the transmission line is the object, it is decided by the digital processing unit 8 using read data whether the past data should be used or not. If the past data should be used, the past data recorded in memory means is used for corona discharge start voltage (S60).

If the past data cannot be used, the corona discharge start voltage V_0 of the transmission line is calculated by substituting the weather forecasts data and the transmission data for an equation. The equation is desirably the following equation 1 and equation 2. Here, m1 is a weather coefficient that is now 1.0 on a fine day and is 0.8 on a rain, snowy day, or a foggy day. It is desirable to decide more accurately one according to actual data collection, m_0: surface coefficient of wire, k: the coefficient decided by structure, r: radius of the element wire of transmission wire (cm), b: atmospheric pressure (hPa), t: temperature (C).

[Equation 1]

$$Vo = 1.178\, m_0 k m_1 \delta^{2/3} (1 + 0.301 / \sqrt{r\delta})$$

[Equation 2]

$$\delta = 0.290\, b / (273 + t)$$

The corona discharge start voltage V_0 is compared with the normal transmission voltage Vn (S80). If the normal transmission voltage Vn is equivalent or lower than the corona discharge start voltage V_0, pre-stored countermeasures voltage is set for set transmission voltage (S90). On other cases, the

normal transmission voltage Vn is set for set transmission voltage (S100). Then, the set transmission voltage of the first transmission line is recorded to memory means 9 (S110). Then, it is checked if all transmission lines have been set or not (S120). If all transmission lines have not been set, 1 is added to n (S130), and next transmission line data is read (S30). In this way, one after another transmission voltages of the transmission lines are set. If the set transmission voltage of all transmission lines (object are the transmission lines that the phase voltage is more than 22kV, is anticipated to generate corona discharge) have been set, these data are sent to the power system analysis means 10.

The power system analysis means 10 decides the load of the apparatuses of the power system in the condition of the set transmission voltage of all transmission lines. According to the analysis result, the load of each apparatuses of the power system is ordered to these apparatuses. The voltage of the transmission lines are adjusted by the transmission voltage regulating means 11. Therefore, the corona discharge generation on the transmission lines is suppressed in advance. Another advantage is that the electric power system can stably supply because analysis of stable power supply is made in advance.

Second Embodiment

Another embodiment of this invention is computer program which comprises weather data input means, memory means, digital processing unit and output means and has the same

function of Fig. 2. In this embodiment, the all transmission line's set transmission voltages which are calculated using the computer program are entered to an electric power system. Then, it is possible to get same effect as first embodiment. The computer readable memory device which stores the computer program or the server in which the computer program is stored is possible to electric power supply company for embodiment.

Third Embodiment

Fig. 6 is a block diagram of example 3 for carrying out this invention. In this embodiment, corona discharge detect means 12, digital processing unit 13 and transmitter 14 are added to the basic structure of large electric power system shown in Fig. 8. In addition, power system analysis means 10-2 and transmission voltage regulating means 11-2 in the basic structure are need to change a little as described later.

The corona discharge detect means 12 is the means for detecting the occurrence of corona discharge at a transmission line. The corona discharge detect means 12 is most desirable in that the ultraviolet light detecting device which is installed near places where people reside has minimal effect conventional electric power systems.

A silicon Photodiode (for example G584 made by Hamamatsu photonics) is most desirable as the ultraviolet light detecting device at the present time. However a semiconductor photo-diode, a phototube, a photoconductive sensor, a photovoltaic sensor, etc. may be used as the ultraviolet light

detecting device. A special filter to distinguish the ultraviolet light from the sun may be used to intercept the ultraviolet light from the sun, so as to detect only the ultraviolet light generated by corona discharge.

The corona discharge detect means 12 may also be to realized by a device for detecting corona noise or a device for detecting a corona sounds.

Digital processing unit 13 converts information detected by the corona discharge detect means 12 into information which is needed by a superior power system analysis means 10-2. The digital processing unit 13 may be realized by a circuit that uses a generally available micro-computer and associated software. The transmitter 14 transmits information converted by the digital processing unit 13 to the power system analysis means 10-2. The transmitter 14 may be realized by wired or wireless means, or by other equivalent means.

When the occurrence of corona discharge at a transmission line that is being surveyed is detected by the corona discharge detect means 12, the fact that the corona discharge has occurred is converted into information needed by the power system analysis means 10-2. The converted information is transmitted to the power system analysis means 10-2 by the transmitter 14.

The power system analysis means 10-2 analyzes other conditions necessary for the power system based on the transmitted information, determines the load on each device, and issues orders to each device. The transmission voltage

regulating means 11-2 also receives orders as part of this issuing of orders ordering. The transmission voltage regulating means 11-2 lowers the transmission voltage of the corona discharge detected transmission line according to the orders. As a result transmission voltage of the transmission line decreases, and the corona discharge stops. If the corona discharge does not stop, the information from corona discharge detection means 12 and the information which has been stored in memory means 15 are again transmitted to the power system analysis means 10-2.

The power system analysis means 10-2 analyzes based on re-transmitted information the power system and determines the load on each apparatuses, and issues order to apparatuses.

The transmission voltage regulating means 11-2 further decreases the transmission voltage of the corona discharge detected transmission line according to the orders.

As a result the transmission voltage of the corona discharge detected transmission line further decreases, and the corona discharge stops.

Therefore, the corona discharge on the detected transmission line is stopped in a short time. Another advantage is that the electric power system can stably provide power supply because the analysis of the power system is made before decreasing the transmission voltages.

However, it is uneconomical to adopt lowered transmission voltages even if the condition has changed so that corona discharge is not generated. An easy method for solving of this

problem consists of returning to the previous transmission voltages at the predetermined time (roughly when weather changes) after decreasing the transmission voltages. If the corona discharge is not generated with the previous transmission voltages, the previous transmission voltages are maintained. If the corona discharge is generated with the previous transmission voltages, the same step as in the corona discharge generation mentioned above is adopted.

Fig. 7 is a block diagram of another example for carrying out this invention.

A weather detecting means 16 is added to the construction of Fig. 6. The weather detecting means 16 is a means for detecting the weather conditions that affect the corona discharge generation voltages, for example temperature, pressure, humidity, etc. The means to send the information which the weather detecting means 16 gets to the digital processing unit 13 is also contained in the weather detecting means 16. The detection of temperature, pressure, humidity, etc, are realized by selecting for each a proper device from the prior art.

When the corona discharge detecting means 12 detects the corona discharge, the weather detecting means 16 detects the weather conditions. The information detected by the weather detecting means 16 is converted by the digital processing unit 13. The converted information is then stored in memory means 15.

After the corona discharge is stopped by the step

mentioned above, the transmission voltage is changed to the previous one, the weather conditions which are newly detected by the weather detecting means 16 are different from the stored weather conditions and are assumed not to generate corona discharges.

In addition, the conditions data which the corona discharge generates for each transmission line are stored in memory means 15. The stored data may be used as past data in the first embodiment of this invention.

While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention.

For example, the electric power system is described as being large scale. This invention is adaptable to smaller scale electric power systems. In a system, partly human operations are possible for this invention.

In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiments disclosed for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

CLAIMS

1. An electric power system comprising:

a weather data input means for inputting weather data, temperature, atmospheric pressure and weather, in the district of an operating transmission line;

a memory means for storing said transmission line data and processed data by a digital processing unit;

a digital processing unit for calculating corona discharge start voltage of said transmission lines and deciding set transmission voltage of the transmission line; and

a power system analysis means;

characterized in that:

data on weather forecasts is inputted for the district,

the digital processing unit calculates the estimated corona discharge start voltage for said transmission line by the data on weather forecasts,

if the calculated corona discharge start voltage of the transmission line is lower than a normal transmission voltage of the line, countermeasure transmission voltage that is recorded in memory means in advance is selected to set transmission voltage of the transmission line,

if the calculated corona discharge start voltage of the transmission line is above the normal transmission voltage of the line, the normal transmission voltage is selected as the set transmission voltage of the transmission line,

the power system analysis means analyzes the load of apparatuses of the power system, and

according to an analysis result, the electric power system operates the apparatuses and transmits electric power.

2. An electronic computer comprising:

a weather data input means for inputting weather data, temperature, atmospheric pressure and weather, in the district of an operating transmission line;

a memory means for storing said transmission line data and processed data by digital processing unit;

a digital processing unit for calculating corona discharge start voltage of said transmission line and deciding set transmission voltage of the transmission line; and

an output means for outputting and transmitting the set transmission voltage of the transmission line;

a computer program including;

a step of inputting weather data,

a step wherein the digital processing unit calculates a estimated corona discharge start voltage for said transmission line, by the weather data,

a step wherein if the calculated corona discharge start voltage of the transmission line is lower than a normal transmission voltage of the line, countermeasure transmission voltage is selected as the set transmission voltage of the transmission line,

a step wherein if the calculated corona discharge start

voltage of the transmission line is above the normal transmission voltage of the line, the normal transmission voltage is selected as the set the transmission voltage of the transmission line, and

a step of outputting and sending the set transmission voltage of all the transmission lines.

3. A computer readable storage medium, for storing the computer program of claim 2.

4. A server for storing the computer program of claim 2.

5. An electric power system comprising:

a corona discharge detection means;

a weather detecting means;

a transmitter;

a digital processing unit; and

a power system analysis means;

including;

stopping corona discharge in a short time by lowering the transmission voltages of a transmission line that generates corona discharge, or stopping transmitting electric power in the transmission line;

adjusting loads of apparatuses in the electric power system; and

operating the apparatuses under an adjusted condition for supplying electric power.

6. The electric power system according to claim 5,

Further comprising:

storing weather conditions before and after occurrence of corona discharge, and

changing the transmission voltage to a previous one, when the weather conditions are assumed not to generate corona discharge.

7. The electric power system according to claim 5, wherein said corona discharge detection means is an ultraviolet light detecting device.

8. The electric power system according to claim 5, wherein said corona discharge detection means is a device for detecting corona noise.

9. The electric power system according to claim 5, wherein said corona discharge detection means is a device for detecting a corona sounds.

10. An electric power system operating method comprising:

a weather data input means for inputting weather data, temperature, atmospheric pressure and weather;

a memory means for storing said transmission line data and processed data, by a digital processing unit;

a digital processing unit for calculating corona

discharge start voltage of said transmission line and deciding set transmission voltage of the transmission line; and

a power system analysis means;

characterized in that:

data on weather forecasts is inputted,

the digital processing unit calculates the estimated corona discharge start voltage, by the data on weather forecasts,

if the calculated corona discharge start voltage of the transmission line is lower than the normal transmission voltage of the line, a decision is made to make countermeasure transmission voltage that is recorded in memory means in advance a set transmission voltage of the transmission line or to stop transmitting electric power on the transmission line,

if the calculated corona discharge start voltage of the transmission line is above the normal transmission voltage of the line, the normal transmission voltage is selected as to set the transmission voltage of the transmission line,

said power system analysis means analyzes the load of the apparatuses of the power system, and

according to an analysis result, the electric power system operates the apparatuses and transmits electric power.

11. An electric power system operating method comprising:

a corona discharge detection means;

a weather detecting means;

a transmitter;

a digital processing unit; and

a power system analysis means;

including the step of;

stopping corona discharge in a short time by lowering the transmission voltages of a transmission line that generates corona discharge,

adjusting loads of apparatuses in the electric power system, and

operating the apparatuses under an adjusted condition for supplying electric power.

ABSTRACT

The present invention provides an electric power system for stably supplying power while suppressing corona discharge generating ultraviolet radiation which may cause health problems in human beings.

The data which are related to the beginning of corona discharge on each transmission line are recorded in a memory means in advance. Data on weather forecasts is inputted for each district so as to calculate the estimated corona discharge start voltage for each transmission line with a computer. If the calculated corona discharge beginning voltage of a transmission line is lower than the normal transmission voltage of the line, the countermeasures of the transmission voltage that are recorded in the memory means in advance are selected to set transmission voltage of the transmission line. The calculation of the estimated corona discharge start voltage and selecting of set transmission voltage are executed on all transmission lines in the electric power system. The set transmission voltage data are inputted to a power system analysis means. The power system analysis means analyze the load of the apparatuses of the power system. According to the analysis result, specific countermeasures are adopted by the apparatuses of the power system.

Fig. 1

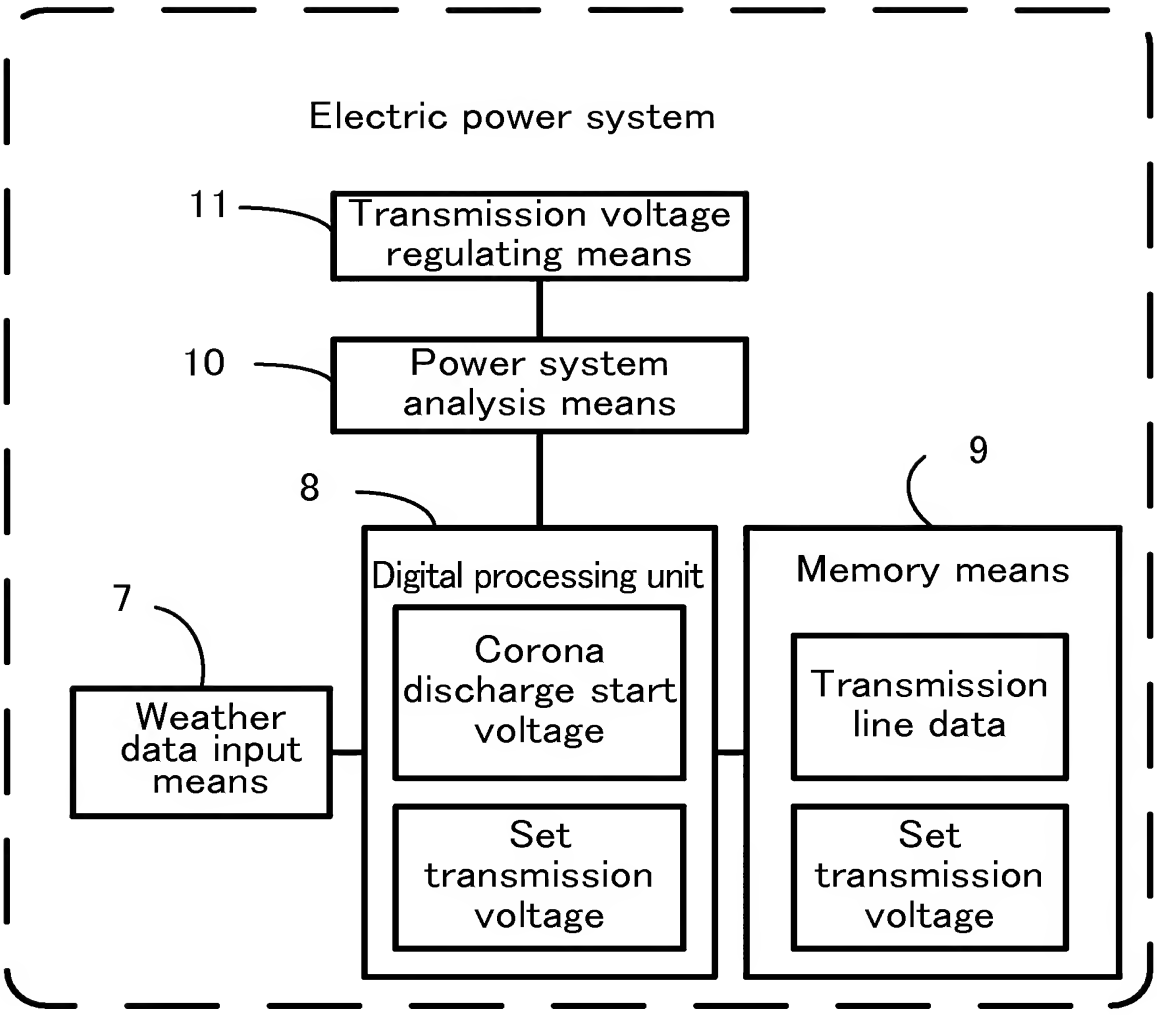

Electric power system
11
Transmission voltage regulating means
10
Power system analysis means
8
9
Digital processing unit
Memory means
7
Weather data input means
Corona discharge start voltage
Set transmission voltage
Transmission line data
Set transmission voltage

Fig. 2

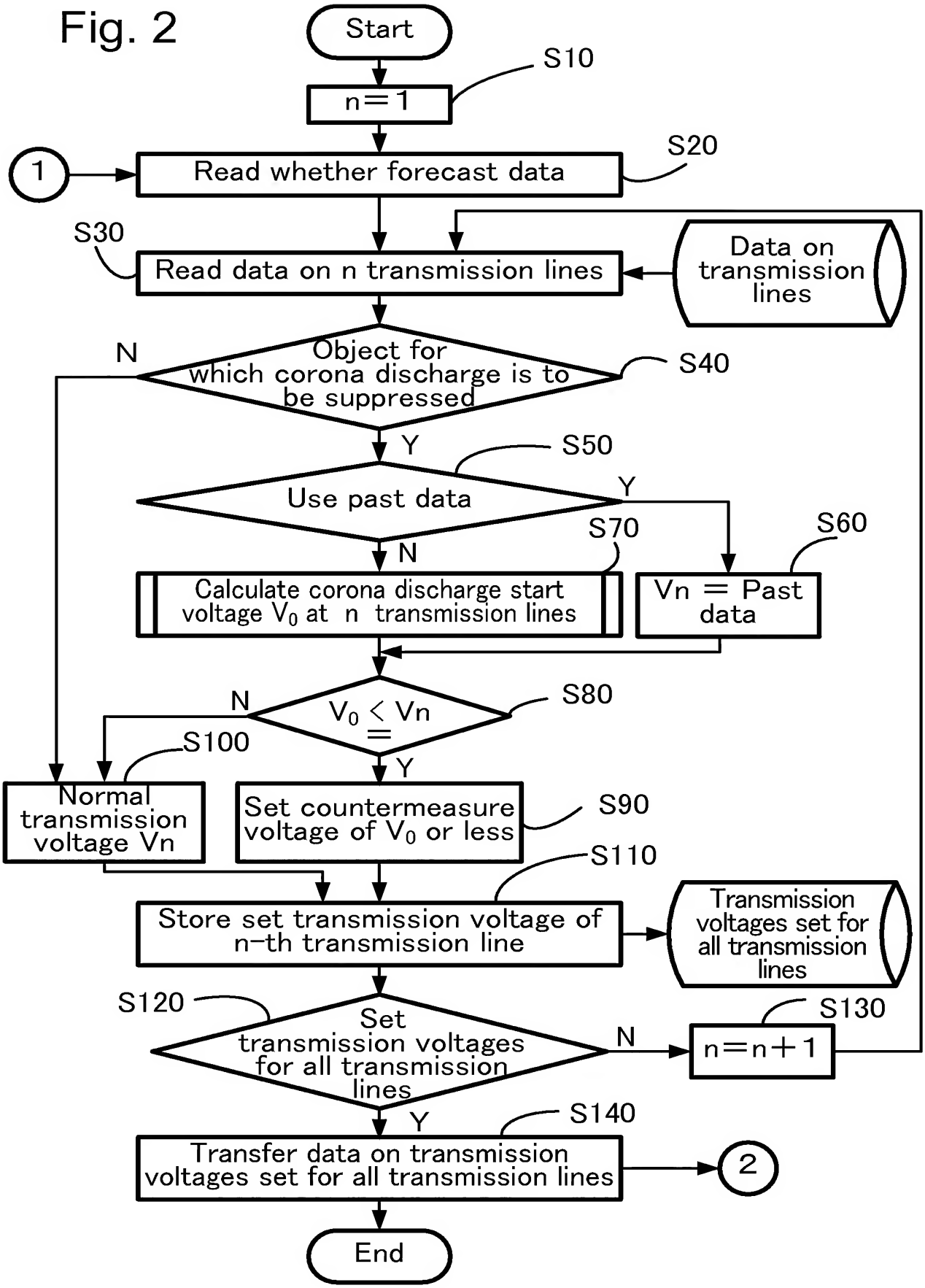

Start
S10
n=1
1
Read whether forecast data
S20
S30
Read data on n transmission lines
Data on transmission lines
N
Object for which corona discharge is to be suppressed
S40
Y
S50
Use past data
Y
N
S70
S60
Calculate corona discharge start voltage V_0 at n transmission lines
Vn = Past data
N
$V_0 \leqq Vn$
S80
S100
Y
Normal transmission voltage Vn
Set countermeasure voltage of V_0 or less
S90
S110
Store set transmission voltage of n-th transmission line
Transmission voltages set for all transmission lines
S120
Set transmission voltages for all transmission lines
N
S130
n=n+1
Y
S140
Transfer data on transmission voltages set for all transmission lines
2
End

Fig.3

area	a	b	c	・・・
Temperature (C)	17	21	20	・・・
Pressure (hP)	1006	1020	1002	・・・
Weather	Rain	Fine	Drizzle	・・・

Fig. 4

Transmission Line	H1	・・・	Hk	C1	・・・	Cj	D1	・・・	Dh
Object for which corona discharge is to be suppressed	Y	・・・	N	Y	・・・	Y	Y	・・・	N
Use past data	N	・・・	—	N	・・・	Y	N	・・・	—
Past data (KV)	—	・・・	—	—	・・・	Rain 185	—	・・・	—
Normal transmission Voltage (KV)	500	・・・	275	220	・・・	220	154	・・・	22
Area where set up	ab	・・・	i	h	・・・	k	l	・・・	n
$m_0 * k$	0.96	・・・	—	0.80	・・・	—	0.68	・・・	—
Measures voltage 1 (KV)	480	・・・	—	190	・・・	180	100	・・・	—
Measures voltage 2 (KV)	450	・・・	—	170	・・・	170	90	・・・	—

Fig. 5

Transmission Line	H1	・・・	Hk	C1	・・・	Cj	D1	・・・	Dh
Set transmission voltage (KV)	480	・・・	275	190	・・・	180	100	・・・	22

Fig. 6

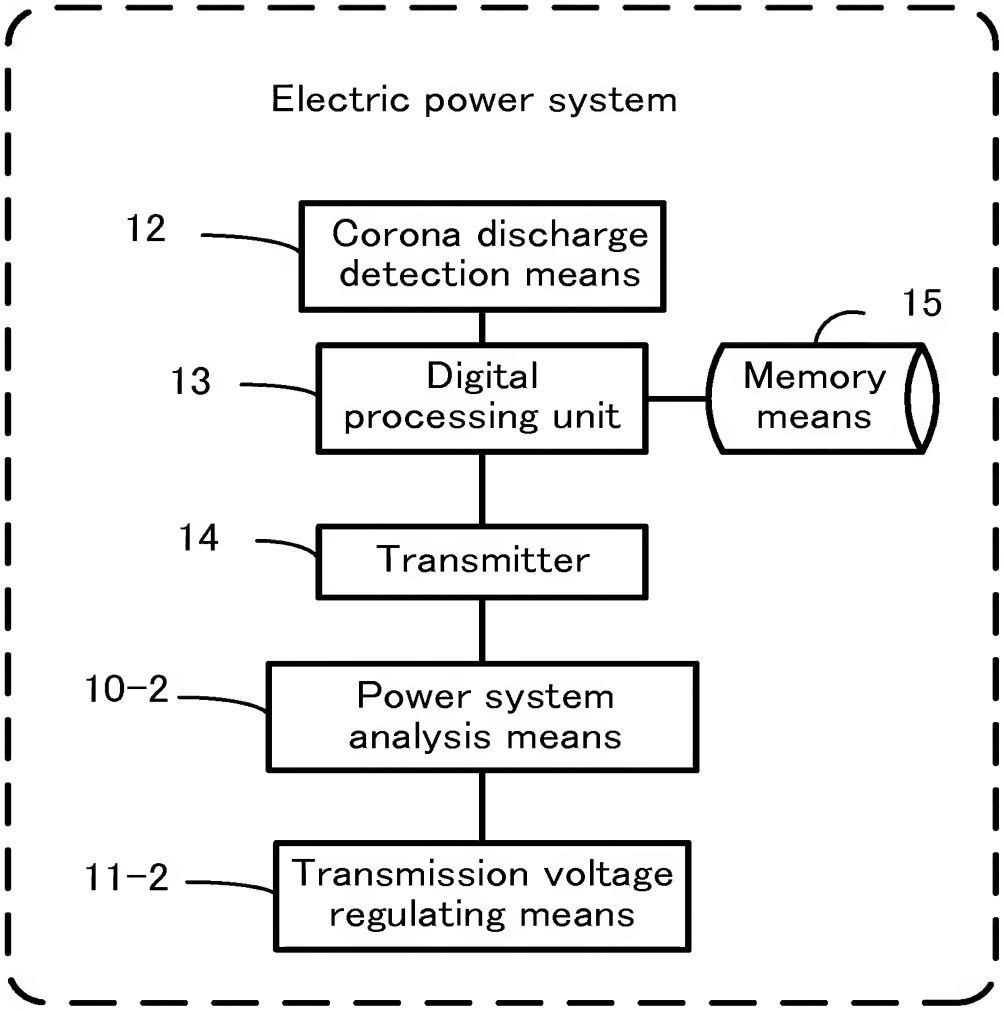

Electric power system
12
Corona discharge detection means
15
13
Digital processing unit
Memory means
14
Transmitter
10-2
Power system analysis means
11-2
Transmission voltage regulating means

Fig. 7

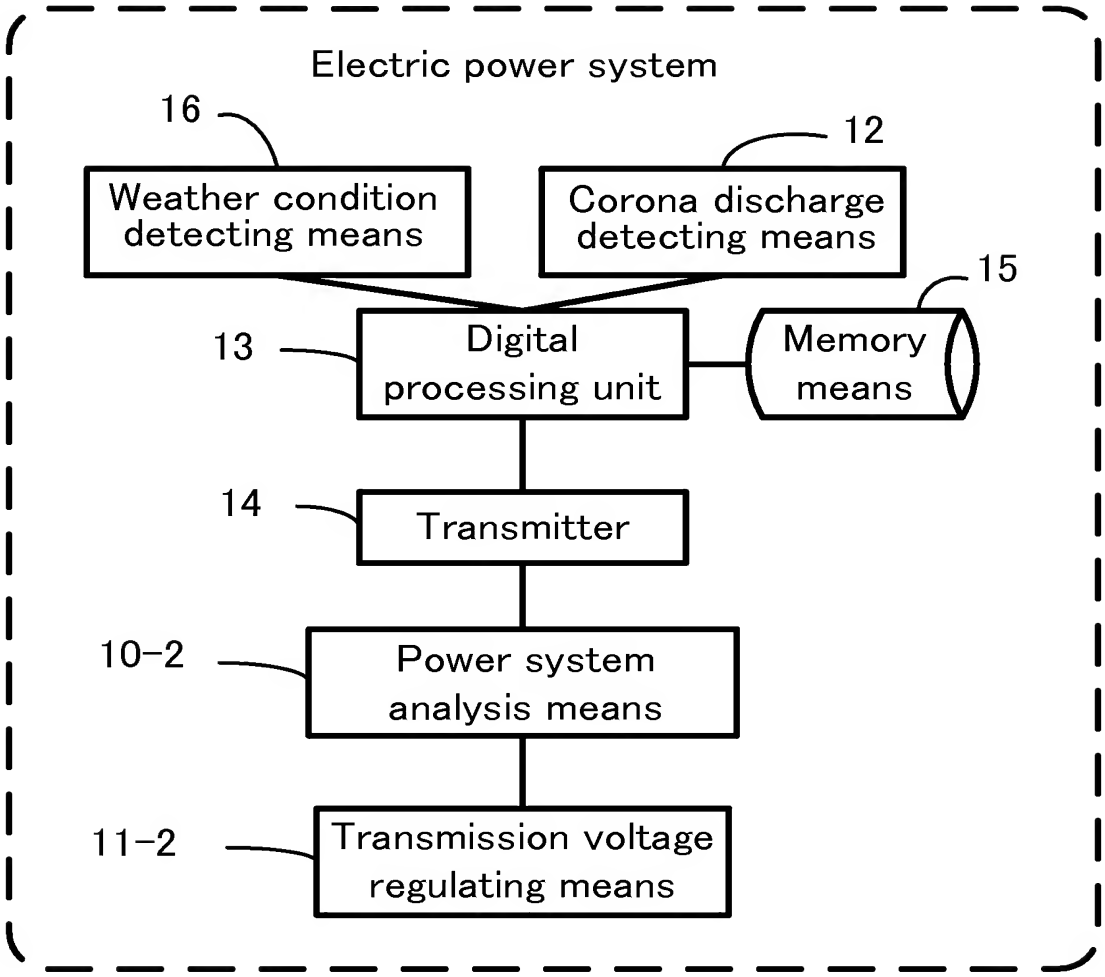
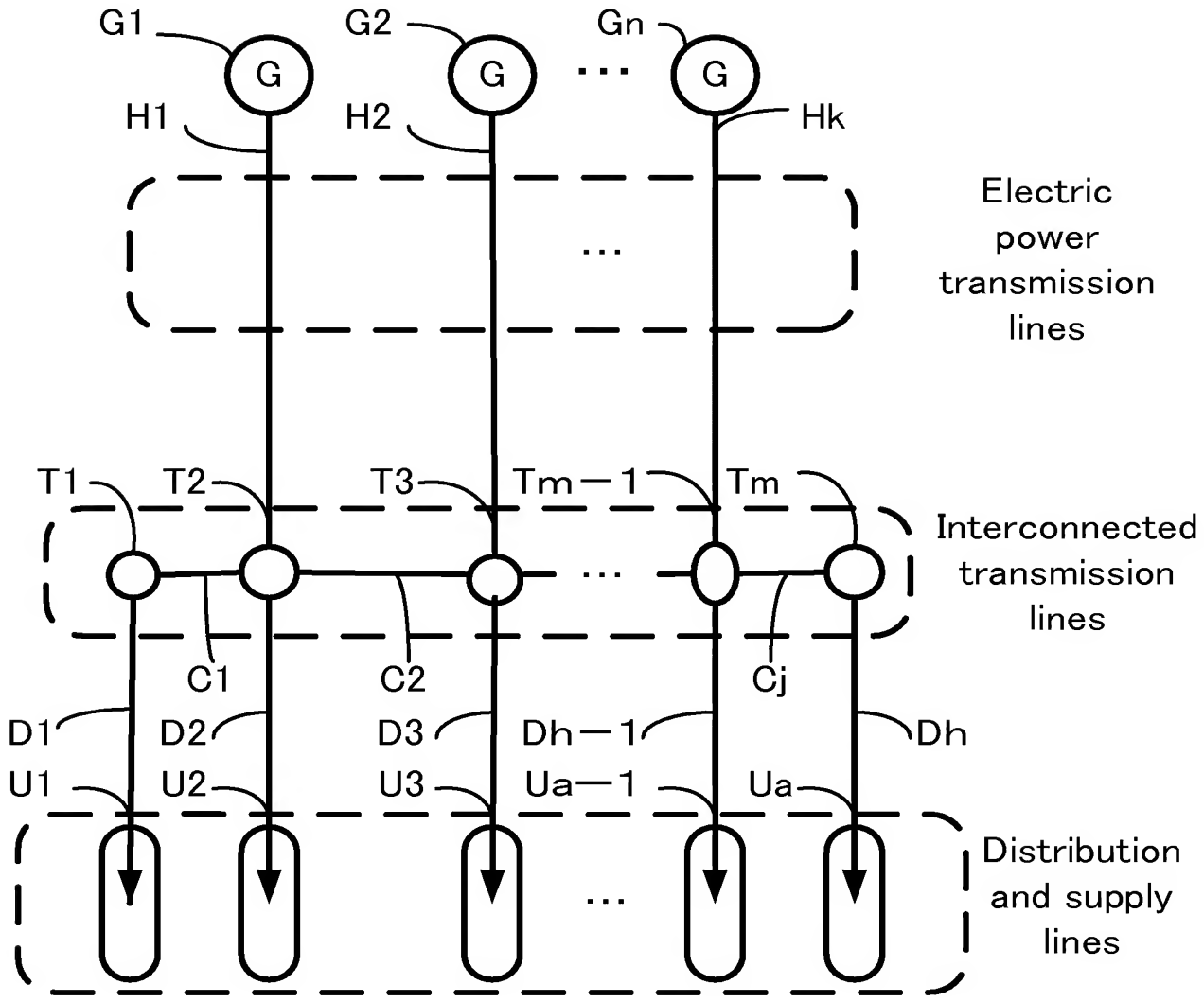

Electric power system
16
Weather condition detecting means
12
Corona discharge detecting means
15
13
Digital processing unit
Memory means
14
Transmitter
10-2
Power system analysis means
11-2
Transmission voltage regulating means

Fig. 8


G1
G2
Gn
G
G
G
H1
H2
Hk
Electric power transmission lines
T1
T2
T3
Tm−1
Tm
Interconnected transmission lines
C1
C2
Cj
D1
D2
D3
Dh−1
Dh
U1
U2
U3
Ua−1
Ua
Distribution and supply lines

CERTIFICATE

I, Takeo SONOBE,
of Sonobe International Patent Office
do solemnly and sincerely declare that I am conversant with the English and Japanese languages and am a competent translator thereof, and that the attached document is, to the best of my knowledge and belief, a true and correct translation of the JP 2003-373850 description filed on November 4, 2003 in the name of ELECTRIC POWER SYSTEM.

T. Sonobe
Takeo SONOBE

March 6, 2008
Date